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IS 10106-1-6 (1992): Packaging code, Part 1: Product packaging, Section 6 Protection against spoilage of packages and their contents by Micro-organisms, Insects, Mites and Rodents [TED 24: Transport Packages]

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भारतीय मानक
पैकेजबन्दी संहिता

भाग 1 उत्पाद पैकेजबन्दी

अनुभाग 6 पैकेजों और उनकी अन्तर्वस्तु को सूक्ष्मजीवों, कीड़ों,
चिंचड़ियों तथा कृत्तकों से खराब होने से बचाने के प्रति संरक्षण

Indian Standard
PACKAGING CODE

PART 1 PRODUCT PACKAGING

Section 6 Protection Against Spoilage of Packages and Their
Contents by Micro-Organisms, Insects, Mites and Rodents

UDC 621.798 : 620.193.8

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FOREWORD

This Indian Standard (Part 1/Section 6) was adopted by the Bureau of Indian Standards, after the draft finalized by the Packaging Codes Sectional Committee had been approved by the Light Mechanical Engineering Division Council.

Packaged goods and their containers are liable to be attacked by micro-organisms, insects, mites and rodents. Foodstuffs and textiles are the products most likely to suffer such attacks with consequent deterioration. Damage to other products include the infestation and decay of wood, rotting of paper, moulding of leather, disintegration of laminated materials, etching of optical glass and discolouration and staining of many kinds of materials.

No attempts have been made to detail techniques for the protection of particular commodities since the many problems involved are too specialized and are best dealt with individually.

The appropriate method of preventing attack will depend on the anticipated environment and also on the susceptibility of the package and its contents to spoilage. While the treatment of the commodity may not be the direct concern of the packer, it will influence the forms of protection which may subsequently be required.

As it is not possible to specify in detail the most satisfactory method for every set of circumstances, the Section gives general guidance and indicates when expert advice should be sought.

In the preparation of this standard, assistance has been derived from BS 1133 (Section 5) : 1985 'Packaging Code, Section 5 Protection against spoilage of packages and their contents by micro-organisms, insects, mites and rodents' issued by the British Standards Institution (BSI).

This Packaging Code is being issued in the following parts, which have one or more sections :

- Part 1 Product packaging
- Part 2 Packaging materials
- Part 3 Ancillary materials
- Part 4 Packaging
- Part 5 Packaging operations
- Part 6 Storage and transportation
- Part 7 Packaging machinery

This Part 1, Product Packaging is being issued in the following sections:

- Section 1 Foodstuffs and perishables
- Section 2 Tobacco and tobacco products
- Section 3 Textiles, fabrics and applied products
- Section 4 Cushioning design for engineering equipments
- Section 5 Marking, addressing and identifications
- Section 6 Micro-biological protection

Indian Standard

PACKAGING CODE

PART 1 PRODUCT PACKAGING

Section 6 Protection Against Spoilage of Packages and Their Contents by Micro-Organisms, Insects, Mites and Rodents

1 SCOPE

1.1 This standard (Part 1/Sec 6) of the Packaging code provides essential information and details to assist packers to take reasonable precaution to protect packages and their contents from attack from micro-organisms (for example fungi, bacteria, yeasts, insects, mites and rodents).

2 REFERENCES

2.1 The following Indian Standard is a necessary adjunct to this standard.

IS No.	Title
10106 (Part 3/ Packaging code : Part 3 Ancillary Sec 4) : 1988	materials, Section 4 Desiccants

3 DEFINITIONS

3.1 For the purpose of this standard the following definitions shall apply.

3.2 Micro-Organisms

Minute living organisms capable of growth and multiplication.

3.2.1 Fungi

Multicellular organisms lacking chlorophyll. Moulds are composed of filaments which when interlaced may form either a compact or loose wool-like growth. Higher fungi (Basidiomycetes) are normally only visible as the fruiting body, for example : Mushroom.

3.2.2 Bacteria and Yeast

Micro-organisms usually consisting of one cell only. As individuals they are microscopic in size but collectively they may become visible to the unaided eye.

3.3 Insects

Six legged invertebrate animals mostly with wings, which in the adult stage have bodies clearly divided into three parts; head, thorax and abdomen. Insects develop from eggs and pass through a number of moults, either involving larval (caterpillar, grub or maggot) and pupal (chrysalis) stages, as in beetles, moths and flies or nymphal stages where the young resemble the adult, as in cockroaches and crickets.

3.3.1 Termites (White Ants)

Insects only distantly related to the true ants from which they differ in structure and life history. They live in large communities made up of individuals of varying form and function. They are widespread in the tropics but only two species occur in Europe.

3.4 Mites

Eight legged invertebrate animals, usually of small size, typically of the order of 0.5 mm long with no clear division between thorax and abdomen. They are more closely allied to spiders than to insects.

3.5 Rodents

Gnawing mammals, for example : rats and mice.

4 NATURE OF AND CONDITIONS FOR SPOILAGE

4.1 General

4.1.1 Packages and their contents are liable to attack and spoilage from a variety of sources in transit and storage. The information given in 4.2 to 4.4 is meant to be informative, offering general guidance without attempting to be definitive.

4.2 Spoilage by Micro-Organisms

4.2.1 Moulds and higher fungi, bacteria and yeast are ubiquitous and their ability to adapt themselves to varied environmental conditions should never be underestimated. Without moisture the development of micro-organisms cannot take place but they are capable of using atmospheric moisture. They can grow over a wide range of temperatures, some at temperatures of cold storage, others at 60°C or above. The temperature which is optimal for growth of many is about 25°C; however for these significant growth would occur in the temperature range of 10°C to 40°C. They will not generally grow at relative humidities of less than 70 percent. Most require oxygen for growth but some tolerate and others require the absence of oxygen. Their food may be supplied by the packaging material, the contents or by films of dirt or grease thereon.

4.2.2 Packaging materials may become discoloured or stained but this does not necessarily indicate a reduction of protective properties. More important damage includes penetration into and loss of strength and the packaging materials or their bonding agents, sometimes leading to partial or complete disintegration. Such damage can lead to a safety hazard to handlers or

to contamination and degradation of the contents, which in turn may result in the production of discolouration, undesirable odours or toxic substances or encourage attack by insects.

4.3 Spoilage by Insects, Termites and Mites

4.3.1 The conditions favouring the development of insects, termites and mites vary greatly according to the species concerned. Most insects will not develop satisfactorily at temperatures below 15°C but some of the important mites will do so. In general, high climatic temperatures are more favourable than low ones, the optima being lower for mites than for insects.

For most insects 70 percent to 75 percent RH is very favourable. Some species are primarily fungus feeders and may require more moist conditions but many including some of the important pests of cereal products will develop and increase at below 50 percent RH. In general mites are less tolerant to dry conditions than insects but a few species survive and develop at about 60 RH.

The infestation may be revealed by bore holes (usually emergence holes), by living or dead insects or their cast skins, debris or it may be hidden with little or no external sign. Their presence as 'fouling' agents within packages particularly those containing foodstuffs often causes much more concern than the loss of product by consumption or leakage.

4.3.2 Many widely distributed species of insects are capable of breeding within food or foodstuff, for example : cereals, pulses, dried fruits and fish meal. Under suitable conditions the rate of population increase may be rapid. Infestation usually starts from eggs laid on the packaging materials, invasion then being made by the very small newly hatched insect through the mesh of the material, pin-hole faults, stitch holes, tears, unsealed overlaps, seams or through poor seals or closures.

Paper, cartons, films and laminates may be perforated by certain beetles, beetle larvae and moth caterpillars and show varying degrees of resistance to the majority of insects. Some may be bitten through and stained by cockroaches, etc. Insects are such more likely to bore exit holes through wrapping material in order to escape than to perforate the material with entrance holes although this can also occur.

Timber, wooden crates, packing cases and wooden products can be damaged by certain beetles and wood-wasps, whose tunnelling and particularly that their larvae impairs the structural strength and marse the appearance. Some live in unseasoned timber only and the attack dies out as the wood dries whereas others live only in seasoned timber.

Textiles and felts can be damaged by larvae of certain moths and beetles and can be spoiled by cockroaches, etc, which stain them.

4.3.3 Termites may be important when exporting to or via tropical and subtropical regions. Many species of termites live and more in soil and the risk of attack

is greatest when the package is in direct contact with the ground. Timber, paper, textiles, foodstuffs and a wide range of other materials can be rapidly and severely damaged. Even when packages are made of termite proof materials such as metal and certain types of timber, attention should still be paid to the method of sealing the container.

4.3.4 Mites can contaminate many kinds of products by their presence in very large numbers and the bodily secretion of some species may taint susceptible foodstuffs. They do not bite through wrapping material but especially in the immature stages they can gain entrance through very small holes and channels through folds or seals.

4.4 Spoilage by Rodents

Three species of rodents as described in (a), (b) and (c) are serious pests.

- a) The common rat (*Rattus norvegicus*) which lives out of door in banks, refuse tips, drains, sewers, etc, and in buildings provided food and water are available.
- b) The ship rat (*Rattus rattus*) which is the less common of the two rats, is found in vessels, buildings ports and occasionally on land. It has more agility in climbing than the common rat and is frequently found living in the upper parts and roofs of buildings. It is not normally found in sewers or in the ground.
- c) The house mouse (*Mus Musculus*) is found out of doors as well as in buildings. It is the most agile climber and can scale the face of rough textured walls. A small mouse has been known to pass through a 6 mm opening. Mice need very little water and will live undetected in stacks of stored foodstuffs.

All three species breed prolifically and if unchecked, their numbers may reach serious proportions.

With the exception of metals and glass all packaging materials and their contents are liable to be attacked by rats and mice. Harder materials such as wood are gnawed while softer materials such as textiles and paper are used to make nests. The amount of food they consume, though considerable, is small in comparison with the value of the goods or materials they destroy, damage or foul. Hence any infestation, however small, should be dealt with as soon as it is detected; often the first sign of infestation is the presence of droppings.

5 PREVENTION OF SPOILAGE

5.1 General

Preventive measures should be selected to suit the individual problems with the economic cost of packaging in mind. However it should also be borne in mind that a slight amount of deterioration of the packaged goods may result in condemnation of the whole consignment. For export purposes, it is essential that packaging materials and treatments should comply with the regulations of the relevant countries overseas.

In assessing the spoilage problem the factors given below will be significant :

- a) *The anticipated environment* : this includes handling, transport and storage conditions likely to be encountered before the product is used or consumed,
- b) *The susceptibility of the package and contents to spoilage* : packaging materials endanger the contents when, as a result of pest or micro-biological attack, they deteriorate to an extent where they cease to perform their prime function. Contents may be laid open to similar attack or left without protection against other deleterious influences. For example, cushioning materials may be spoiled increasing the chances of physical damage or barrier materials may be penetrated resulting in ingress of moisture and the attendant chances of corrosion or rot, etc.

Once the particular problem has been assessed as accurately as possible selection of the most suitable protective treatment can be made. Treatments available are many and varied and can be of such a specialized nature as to make it imperative to choose and apply them with expert advice or supervision. For example, the choice of insecticides and disinfectants should involve consideration of toxic hazard, tainting or deterioration of the commodity.

It may be extremely costly, relative to the value of the commodity, to ensure that all possible spoilage hazards have been guarded against by treatment of the commodity or by special design of the package. In the interests of overall economy therefore it may well be preferable to eliminate some of the hazards. Attention to the handling, transport and storage conditions, for example, through the provision of adequate hygiene and cleanliness, pest control, air conditioning or even refrigeration may enable more economic packaging to be used.

In 5.2 to 5.5 guidance is given on some of the methods available for the prevention of the forms of spoilage already listed. Whilst reference to specific methods has been omitted, the general principles to be followed are outlined. For practical purposes it is convenient to categorize preventative measure as follows :

- a) Control of environment,
- b) Treatment of commodity to be packed,
- c) Protection afforded by the package, and
- d) Treatment of the packaging materials.

5.2 Control of Environment

5.2.1 General Considerations

The environments of packages before final delivery may include, in addition to the buildings in which they are stored, transport by rail, road, water or air and the extent to which detrimental factors associated with these can be controlled will be limited by practical and economical considerations. Nevertheless, attention to environment on the lines indicated below for buildings

will do much to prevent spoilage and avoid the necessity for further control measures. Enclosed vehicles and vessels or freight containers should be used where practicable, otherwise goods should be adequately protected against moisture during transit, and where necessary provided with suitable ventilation.

The amount of moisture present should be kept as low as possible in order to minimize the likelihood of attack. Conditions which allow the package to take up water by absorption should be avoided. Therefore buildings used for packing and storage should be dry and kept at as uniform a temperature as is reasonably possible. The structure should be waterproof and provided with appropriate barriers to prevent damp rising from the ground.

The elimination of rough surfaces and filling in of cracks and crevices in the fabric of stores, warehouses and other buildings as well as doing away with as many hollow spaces inside buildings as possible for example floor spaces, hollow partitions, pipe ducts, by reducing harbourage for insects, rodents, etc, and making cleaning easier will help to prevent the breeding or spread of pests. Where such cavities cannot be avoided measures should be taken to prevent rodents entering.

Horizontal surfaces which harbour dirt and dust should be reduced to a minimum and the adoption of a cove in the angle between walls and floors will facilitate cleaning.

Buildings for storing commodities, particularly food, over long periods should be regularly and carefully inspected and if any sign of an infestation is found the appropriate expert treatment should be undertaken immediately. Such buildings should be maintained in a high state of cleanliness because organic dusts, food spoilage and damaged food containers encourage the breeding and growth of pests. Regular cleaning by brush and vacuum cleaners should be carried out. Particular attention should be paid to horizontal surfaces, normally inaccessible places and cracks and crevices in the floors and fabric of the building generally.

Entry and nesting of birds should be prevented as nests encourage the breeding of insects and in some instances provide food for mice.

Commodities in store in buildings should be on racking or in reasonably sized stacks on pallets, with gangways at least 1 m wide all round to allow for inspection, cleaning and treatment of the commodity should this be necessary. The enclosure of stanchions in stacks should be avoided. Where pallets are not used goods should be stacked at least 150 mm above floor level on dunnage, to prevent the absorption of damp from the floor and to facilitate cleaning and air circulation. Stocks should be used in strict rotation to avoid accumulation of old stock.

Mixed stacking and stowing should be avoided. The juxtaposition of packaged goods and raw materials is particularly undesirable owing to the danger of the former becoming infested. All waste material should

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be immediately disposed of, preferably by incineration, in order to prevent the spread of an infestation and to avoid attracting pests.

Reusable packagings or shipping containers may be a source of infestation when they are brought into premises and kept or stored whilst awaiting treatment by a cleaning process. It is essential that this hazard is not underestimated and separate storage arrangements should be made if possible. It is emphasized that although normal cleaning may remove visible residues this does not necessarily eliminate any infestation present (see 5.5).

In addition to the above general considerations, certain terms of infestation demand special precautions which are given in 5.2.2 to 5.2.4.

5.2.2 Micro-Organisms

Special treatment against micro-organisms will be unnecessary if the moisture level of the materials and the relative humidity of the storage area can be kept low and a high standard of hygiene maintained. In some instances, for example, tropical climates, it may be necessary to provide special storage conditions or to treat packages with a biocide or both.

5.2.3 Insects and Mites

Infestation by insects or mites tends to show itself on the surface of the stacks. Low moisture content and good hygiene will reduce the probability of such a attack.

The entry of larger insects, especially flying ones, may be prevented by the use of suitable wire mesh over permanent openings; other openings such as doors and windows should be kept closed.

Preventive measures against development of infestation may be taken by treating the fabric of a building and the insides of vehicles, freight containers and vessels with insecticidal sprays, dusts or lacquers. Where infestation has established itself similar methods can be used with the addition of fumigation. All treatments should be undertaken under expert advice and carried out by trained personnel.

5.2.4 Rodents

In order to exclude rats and mice from buildings any openings in excess of 5 mm should be closed. Vulnerable points where an entrance can be made by gnawing such as timber doors, door frames, accessible windows, etc, should be protected with metal and permanent openings such as ventilators with 5 mm mesh metal.

Undergrowth round a building should be removed as this is liable to harbour rats and mice.

Uncovered water containers and faulty water fittings such as dripping taps provide water for rats and mice and should not be allowed.

Rats may enter a building from the drains and all sanitary fittings and drain connections should be maintained in good condition.

Rats can jump to a height of 600 mm and both rats and mice are good climbers. Mice are quite capable of climbing vertical surfaces.

Rodents are occasionally carried into storage premises in the commodity or the vehicle carrying it. In order to minimize this risk vehicles should not stand for long periods, particularly at night, in places where they may become infested.

Rodent barriers and doors may be provided and should be closed whilst a vehicle is inside a building.

If rats or mice are found in a building, vehicle, shipping container or craft, treatment should be carried out under expert advice and in buildings liable to re-infestation the provision of permanent baiting points is a useful precaution.

5.3 Treatment of Commodity to be Packed

5.3.1 Since package by itself cannot be expected to overcome the problems of packing infested material of very perishable products, many commodities are already treated to combat spoilage, for example, by the heat sterilization of canned foods the pickling, freezing or drying of foods, fumigation and irradiation. It is possible to ensure that goods are free from living insects by fumigation, mechanical screening and the use of mechanical infestation destroyers for powders.

It is essential that the moisture content of the commodity and all other materials enclosed within a moisture barrier be reduced to a level such that the relative humidity inside the barrier never exceeds 70 percent of any of the temperatures to which the package may be subjected, unless chemical preservatives which prevent mould and bacterial degradation of fabrics, paints, inks, adhesives, plastics, etc, are used. The use of insecticides, including the chemical treatment of wool to mothproof it, is another way by which the product can be protected and so it reduces the demands made upon the packaging material.

Treatment of the commodity in these ways may not be the direct concern of the packer but he should be aware that much can be and may have been done during manufacture to protect an article and this may reduce the need for resistant or specially treated packaging materials. When goods are to be sterilized after packing (for example, pharmaceuticals by ethylene oxide fumigation) it is essential that the package is compatible with the process. Close collaboration between manufacturer and packer is always advisable.

5.4 Protective Packaging

5.4.1 General

Careful selection of the packaging materials can greatly reduce losses due to biological deterioration. The protection afforded by the packaging arises largely from the creation and maintenance of an adequate physical barrier which may prevent the ingress of spoilage agents and the formation of conditions inside the package favourable to the growth of micro-organisms already present.

However, since the packaging materials may themselves be subject to attack, they may need protective treatment so that they can function satisfactorily. Chemical treatment of the packaging materials can also sometimes be given specifically to protect the contents.

5.4.2 Protection Against Micro-Organisms

Micro-organisms thrive on materials that provide them with easily utilizable food. Hence, unless a preservative is incorporated, natural adhesives are more susceptible to the growth of micro-organisms than most synthetic adhesives and similarly starch and casein coatings on paper and board accelerate mould growth. On the whole plastic films are not attacked unless a susceptible plasticizer has been used. A good general guide to the susceptibility of the contents of the packaging materials to microbial attack is that the higher the proportion of water extractable compounds present, the more readily will deterioration occur under damp conditions.

Control of the moisture content of a package is the simplest way of preventing deterioration by micro-organisms. Good ventilation of packages of non-hygroscopic products may be sufficient in climates which do not have a prolonged humid season. An effective moisture barrier is normally advisable whenever materials are packaged for transport or storage in areas where the general relative humidity is greater than 65 percent. These conditions can occur in temperate or tropical conditions where diurnal fluctuation of temperature can result in condensation and higher relative humidities within confined spaces. Goods stored in waterproof warehouses and during transit by sea are particularly at risk.

When a water vapour barrier is used the product and any cushioning materials, etc, inside the barrier should be as dry as possible (*see 5.3*) the weight of hygroscopic material should be kept to a minimum and the free space in the package should be reduced as far as possible to minimize the risk of condensation. In these circumstances the use of a desiccant may also be necessary [*see IS 10106 (Part 3/Sec 4) : 1988*].

With certain products the combination of low oxygen permeability with a moisture vapour resistant barrier will delay the onset of deterioration. Extreme caution should be exercised if natural materials such as straw are used for cushioning as these materials can carry and so increase the number of spoilage organisms. Synthetic materials such as expanded polystyrene may be preferable cushioning materials. Generally synthetic wrapping materials are less susceptible to attack than untreated paper and fibreboard.

5.4.3 Protection Against Invading Insects

Insects, especially in their immature stages, are capable of entering packages through very small openings. Hence it is important to eliminate such weak points as far as possible by suitable design of the package and also by careful attention to the closing operation.

Paper and plastic film bags and sacks will clearly be superior to more open structures. However, where a stitched neck is used, stitch holes and the mouth of the sack are open to invading insects. These openings should therefore be closed by completely covering them with adhesive tape. Where practicable, heat sealing is preferable since this gives complete fusion of the two sides of the bag and leaves no point of ingress for insect invaders.

Corrugated fibreboard outer cases are widely used to contain consumer sized packages but are not easy to seal completely. Either the flap joints and corners should be sealed with adhesive tape or the whole outer case enveloped in a complete shrinkwrap of plastic film. Consumer sized paper board cartons are also difficult to make insect proof though again careful design of the carton flaps and adhesive placement will help. As for outers, complete overwrapping with a sealed plastic film is probably the best approach.

Where complete protection against invading insects is essential then the preferred type of package is a rigid metal, plastics or composite can or glass jar with a hermetic closure or a fully heat sealed plastic bag or flexible laminated pouch.

5.4.4 Protection Against Boring Insects

Borers pose a more difficult problem than invaders as they can penetrate completely sealed packages. Only heavy metal or glass containers will be truly impervious to insect penetration and these should be used where an extended shelf life is essential for a foodstuff under very adverse conditions of infestation. However, in many instances the lesser protection offered by other types may be taken as a guide to their suitability.

In general the resistance offered by packaging materials to penetration by boring insects is determined by four interdependent factors that is hardness, surface smoothness, rigidity, and thickness. Hence choice of material is important for the first three factors and the last is important for any material chosen.

Paper, board, cellulose film, low density polyethylene and plasticized PVC films are probably the least resistant materials to insect penetration. Polypropylene, particularly if oriented, and polyester are among the more resistant materials. Laminated flexible materials will allow the use of a resistant outer material with an inner ply which has excellent heat sealing properties but poor resistance to penetration. Aluminium foil laminates offer good resistance to penetration but aluminium foil at the thicknesses normally used in flexible laminates can be penetrated by some insect bores.

Complete protection against boring insects can only be given by metal cans and glass containers with metal closures. However some thick walled plastic containers or composite cans with double seamed metal ends are almost as good. For any container other than one giving complete protection, the degree of resistance to borers can only be accurately gauged by experiments with those particular species of borers which the package will encounter in the field.

5.4.5 Protection Against Rodents

It is expected that transport and warehousing conditions will be such as to discourage rodents from access to packages containing food. To prevent the invasive entry of mice, fibreboard cartons should be taped securely at all possible points of entry and other containers sealed as appropriate. Mice can gain access through small holes of the order of 6 mm in diameter.

Rats can gnaw through most paper, board, wood and plastic containers and flexible laminates, though it is apparent that tougher and thicker containers will offer greater resistance. However, complete protection can be obtained as for insect borers by the use of metal cans or glass containers with metal closures.

5.5 Treatment of Packaging Materials

Paper, fibreboard and timber can be effectively treated

with anti-microbial agents. Insecticides and insect repellents can be applied to a variety of materials and specific treatments are available to improve the termite resistance of timber.

The choice of proofing agents is a complex matter and expert guidance should always be sought in the selection and application of these special processes.

The possibility of taint or contamination of the contents should be considered.

If containers are intended for reuse, special care should be taken to ensure that they are those kinds that can be adequately cleaned and treated. This can be done, for example, with jute sacks, bottles, jars and timber packing cases. Sterilization or fumigation of such containers may be a necessary precaution.

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Doc : No LMD 26 (920)

Amendments Issued Since Publication

Amend No.	Date of Issue	Text Affected

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